



TOOLS

of the trade



KATHY ARNOLD
describes her
experience using the
Assessment for Common
Misunderstandings
Tools with her students.
As with any tool, she
explains, it is how you
use the tool that makes
the difference.

This article outlines one teacher's efforts to build her knowledge of students' understandings of mathematics whilst catering for different abilities within a Year 1 classroom, using the freely available *Assessment for Common Misunderstandings tools* (Department of Education and Early Childhood Development [DEECD], 2007).

It was whilst undertaking postgraduate study in primary mathematics teaching that I began a journey which focussed on improving my own understanding of how children learned mathematics and what constituted best practice in assessing children's understanding of mathematics. As the DEECD (2007, para. 1) points out, "scaffolding student learning is the primary task of teachers of mathematics, but this cannot be achieved without accurate information about what each student knows already and what might be within the student's grasp with some support from the teacher and/or peers." It was at an early stage of my studies that I first became aware of these tools, which were to become the most important 'tools' of my trade.

Charles (2005) makes reference to key features of effective mathematics teachers which include "the grounding of a teacher's mathematics content knowledge and their teaching practices around a set of *Big Mathematical Ideas*" (p. 9). The *Assessment for Common Misunderstandings* materials have been "designed to assist teachers identify

student learning needs in relation to a small set of big ideas in Number without which students' progress in mathematics is likely to be seriously impacted" (DEECD, 2007, para. 1). The tools provide diagnostic tasks that assess these big ideas from Prep to Year 10, *Victorian Essential Learning Standards* levels one to six inclusive (Victorian Curriculum and Assessment Authority, 2007). All of the tasks are short, quick and easy to administer.

Getting started

I first used the tools by implementing the *Level 1.1 Subitising tool* with my whole class during March. No training and minimal preparation was necessary: I read the relevant page, printed the cards and off I went. I was pleased with how little time this actually took—probably about a 100 minute block of administrative planning time to rotate through the whole class. However, after deciding to address the issue of subitising 'whole class', I quickly moved onto the *Level 1.2 Mental Objects tool*. This particular assessment comes in two parts: the first one uses four counters in a small, non-transparent container with an additional five counters; the second is a small card covered by two flaps, one half has nine dots, the other half has seven dots. The second part of the task is only undertaken if the student is successful at the first part. Again, the tool was quick to implement, with minimal preparation and gave me very clear direction for teaching. The advice helped me to group the students into three stages of development—perceptual, figural or conceptual counters—and gave specific advice as to what sort of activities were required at each stage in order to move these students forward.

Creating student activities

Following this first round of assessment, the advice for teaching enabled me to form three groups of students based on like needs.

The first group (six students deemed to be perceptual counters) was given the task of counting on from a given number using number cards and 6 sided dice. This activity came straight from the teaching advice with no modification whatsoever. The second group (figural counters) worked in pairs using subitising cards and dominoes, explaining to their partner *what they saw and how they saw it*. The third group consisted of two students (conceptual counters) who worked with tens frames solving mental addition problems and playing games like *Place Value Path* (Siemon, 2000.) The activities were repeated for periods of about ten minutes at the start of our mathematics sessions for about two weeks. The children seemed to enjoy the familiarity of the activities and I was able to roam from group to group, intervening when necessary.

Student progress

When I repeated the *Mental Objects* tool in May, I was pleased to find that most of the children had made significant progress. Most of the perceptual counters had become figural counters. Mason, who had initially been slow to work out an answer and explained that he had "just guessed," was, by May, *counting on* using his fingers. Nakisha had been counting all in March was also *counting on from the larger number*. Charlotte had been a figural counter, using her fingers to count on from the larger of two numbers. By May, she was using part-part-whole strategies without her fingers: "I knew that five and five was ten then I took one away." Louis was also counting on initially, but had become automatic using a build to ten strategy to solve the *Mental Objects* card task.

Teacher learning

From about mid-year, I also started slowly to introduce the Level 2 tools that deal with the next 'big idea', that is, *place value*. This is where things really became interesting in terms of

my understanding of children's mathematical development. The Level 2 tools—four tools in total, all with multiple components—led for complex assessment, complex results and a range of teaching activities that were required in response to the assessments. Having said that, again the tasks are all short, easy to administer and very manageable.

The biggest enlightenment for me was in terms of the depth of knowledge required for robust understanding of the big idea at Level 2, place value. *The Level 2.1 Number Naming tool* has four different components, one of which related to bundling of icy pole sticks. After multiple playing of a place value game in which students repeatedly make bundles of ten with icy pole sticks, I am happy to report that the majority of my children did very well at this task. In previous years, I believe that I would have interpreted this information as my students having a fairly solid understanding of place value. The kidney beans task, however, really seemed to bring students' misunderstandings to the fore. They were asked to count 26 counters and write down the number of counters. Then they were asked, "Does this have anything to do with the number of counters you have there?" about the six in the number and then the two. I was amazed by the regularity of responses where students were unable to articulate that there were 2 tens and 6 ones. For instance, Sarah said, "The two means the twenty in the number. That number is something six." Luca also stated, "The two means it's twenty something, then there's a six."

Very few of the students, including Hugo who had began the year as a conceptual counter, were able to articulate that the numbers represented the tens and ones. This led to very clear teaching advice which suggested that students at this stage needed experiences where they "practice *making, naming and recording* tens and ones, emphasising the count of tens in the tens place and the count of ones in the ones place."

The Number chart task (another component of the *Level 2.1 Number naming tool*) also

challenged many children, particularly the part that asked them to recognise a counting by tens pattern, but one where the fives in the ones place dominated. The majority of children insisted the pattern was counting by fives even when they had successfully continued the pattern independently. Sarah was able to correctly identify the pattern as counting by tens but only continued it successfully to 105, and then continued 205, 305 and so on. Ethan continued the pattern to 95 then switched to counting by fives, which he insisted was the counting pattern. Lexi was able to continue the pattern which then enabled her to work out that she had been counting by tens. The overwhelming theme was that children could continue the pattern but most believed that they were counting by fives. Again the advice was very clear, suggesting that students were "likely to be distracted by visual perception suggesting understanding of place-value pattern not very robust, may only understand count of tens in terms of multiples of ten and ones" and offered very specific teaching recommendations.

Responding to student need

At this point in the year, things became complex as I tried to address the variety of student learning needs. At no point did I go past two digit place value with the entire class as I was conscious of not advancing the students too far too soon. However, there did come a point with some children where the advice indicated that the introduction of three-digit place value should be the next step for them.

In late July, I moved those of the class who had been relatively successful with the *Level 2.1* tool onto the *Level 2.2 Efficient counting tool*. This uncovered a whole other set of issues in terms of efficient counting. This tool is divided into two components. The first requires the student to count 56 unifix cubes as quickly as possible, the second to count 13 bundles and 16 single icy pole sticks.

The unifix component of the activity uncovered many students' inefficiency with counting large collections of objects. Many of the students were counting by ones and not grouping objects for easy recounting. The rubric advice recommended:

Chicken scramble—a purposeful counting activity which involves placing a large amount of counters (enough for about 40–50 per student, the ‘chicken feed’) in the middle of a group of students (the ‘chickens’). Students are advised not to be greedy chickens then, on the word, “go”, students collect their share of the food. Before counting, students are asked if they think anyone has been greedy (amounts can be moved around accordingly), then the ‘chickens’ are asked to count their ‘food’ to see how fair their share was.

The class loved the activity, and repeating it allowed me to cover several learning objectives at once: estimation, development of more efficient counting strategies, which included my modelling on several occasions, and recording and ordering of tens and ones.

The icy pole sticks component of the *Efficient counting* tool also uncovered some very interesting misconceptions. For example, Nakisha was able to count out the bundles of tens and then the individual sticks but was

unable to add the ones onto the 130—"I wasn't sure what's after 130." Tom counted aloud by tens, accurately, to 130, then started counting by ones from 300.

Making it manageable

By Term 3, the groupings within the class were quite complex indeed, with one set of three groups organised around the results of the *Mental Objects* tool results, and another set with two groups based around the outcomes of the *Number Naming tool*. The first set of groups had 13 students (two of whom were new to the school) working together on part-part-whole ideas and subitising. The advice suggested that I “make this knowledge explicit by asking students to say what they know about a given number, e.g., ‘6 is double 3’, ‘it’s 2 more than 4, 1 less than 7, 4 less than 10’ and so on — record on posters and display, review regularly.” Figure 1 shows an example of a poster created by these students in a series of lessons on part-part-whole. They also worked on the carpet with me with some quite intensive sessions using subitising cards, the idea being to promote as many ways as possible of children ‘seeing’ the dots, with me asking, “What did you see? How did you see it?”

It was recommended that another group of four students needed to “use this knowledge to scaffold the *count-on-from-larger mental strategy* for single digit combinations involving 1, 2 or 3, for instance 2 and 7 presented orally, students count on from 7 saying, 7... 8, 9 without relying on physical models.” I worked with this group using tens frames and dice to explicitly teach strategies for addition.

The group of four working at a higher level were given assorted games and activities to deepen their understanding of place value. I then introduced them to the *Level 2.3 Sequencing* tool and the *Level 2.4 Renaming tool*, which recommended moving onto 3 and 4 digit place value, which I began with these students, albeit moving very slowly and

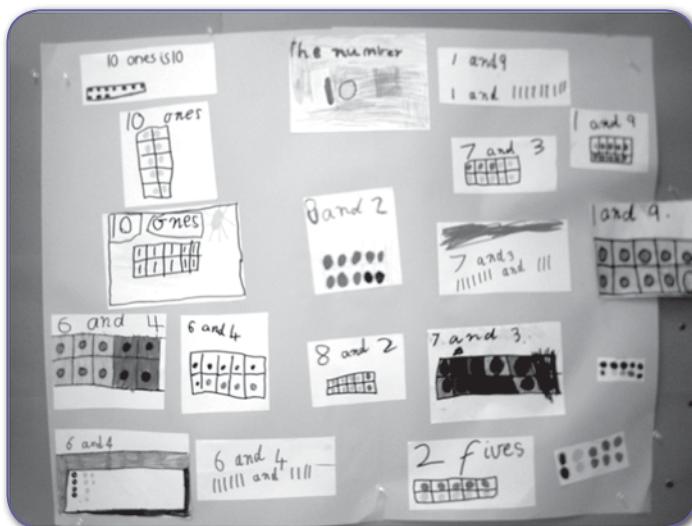


Figure 1. The Mental Objects tool advice recommended making posters for the development of part-whole ideas for the numbers 5-10.



Figure 2. Louis completes the Level 2.3 Sequencing Tool.

really focussed on conceptual understanding. The *rope task* of the *Sequencing tool* uncovered misconceptions for these students. They were asked to place the numbers 26, 67 and 48 on a piece of rope approximately one metre long. Interestingly, all students attempting the task, although they did a reasonable job of placing the numbers, were deemed by the advice to have “numbers larger than 20 placed more or less correctly, but actions and/or reasons given suggest counting rather than halving or partitioning strategies.” When asked to justify their positioning of numbers on the rope, they all gave similar explanations. Louis suggested that he placed the number 48 on by “getting a picture in my head then I counted backwards from 100 to 48 by twos” (see Figure 2). Hugo also counted along the rope by twos and therefore misplaced the number; he added that, “I just guessed for 26.”

The advice suggested that appropriate teaching strategies for these students were to “review and discuss every-day halving, e.g., halving an orange, a length of paper tape, a piece of paper etc. Also to review *doubling and halving*, discuss numbers in terms of their relationship to other numbers, e.g., 10 is half of 20, 30 is half of 60 and so on, demonstrate in class using a 3-4 metre length of rope, number cards and pegs.” This is what I am currently addressing with this small group of students.

Benefits

There are many benefits to using the *Assessment for Common Misunderstandings Tools*. The main one is that specific advice is given for virtually every response that a student can potentially give. Although one can be as creative as one wishes in interpreting the advice, there is really no need to be adventurous at all. Once one is familiar with the tools it can be as simple as ‘if the student does this, the teacher does this, or if the student does that, the teacher does that.’ One can be as vigorous as one likes with conducting the assessment and creating groups. The more familiar you become with the materials, the quicker and easier this becomes. As Siemon (2011) asserts:

[A] focus on the big ideas in Number works. Teacher feedback on the use of the *Assessment for Common Misunderstanding* (ACM) materials prepared for the Victorian Department of Education and Early Childhood Development, report significant improvements in student engagement and progress where student learning needs in relation to a small number of ‘really big ideas’ in Number are more accurately identified and the teaching is more closely targeted to meeting those needs.

An important thing to remember is that the whole point of the tools is to provide guidance in terms of the learning needs of your students. Although I have outlined the path that my teaching has taken over the course of this year, it would most certainly differ with a different cohort of children, in response to their needs. The activities that I selected for my students were very much in response to their needs, with me making choices on what to prioritise. With the students who were ready for three-digit place value, I made a conscious decision not to accelerate their learning but to really consolidate a deep understanding of two-digit place value. For those students who had not fully developed their part–part–whole

understanding, I made a concerted effort to hone in on this with lots of exploration of subitising cards.

Secondary to the advantages for my students was the benefit of my own personal growth as a teacher of mathematics. Through engaging with the materials I have further developed my own understanding of students' learning trajectories. I look back at my March anecdotal notes and think why did I not record whether or not the student was showing some sort of behaviour? As my familiarity with the materials grew, so did my ability to interpret the results. Having used the *Level 1.2 Mental objects tool* consistently throughout the year, I now feel very confident in my capacity to interpret a child's responses to the tasks. With the *Level 2.3 Sequencing tool*, however, where my experience was much less extensive, I needed to refer to the advice far more closely.

In conclusion, if teachers are interested in developing their knowledge of children's understandings of number and looking for an alternative means of assessing children's learning, I invite them to try the *Assessment for Common Misunderstandings Tools*. My advice for teachers starting out with the tools would be to do what you can manage and incorporate the advice into your own teaching in ways that suit you and that enhance your own teaching style. This might even lead to these resources becoming, as they have for me, invaluable 'tools of my trade.'



Figure 3. Keep all of your *Common Misunderstandings Tools* materials together with the instructions and advice in a display folder.

TOP TIPS

1. Create a *Common Misunderstandings toolkit*. Print the instructions and advice and keep in a display folder (Figure 3).
2. Create proformas for the results in order to organise your students' responses. Use different coloured pens to indicate the dates when the assessment was revisited.
3. Keep a detailed assessment book with one or two double pages per child. Use post-it notes to add observations as they occur.
4. Sit where you can see what the child is doing, probably across the table, so you can see what they are doing with their fingers. Long-term reliance on using fingers can be unhelpful to the development of efficient mental strategies.
5. Begin by assessing the big idea of the VELS level below your students' expected level.
6. If you feel that using the tools with all of your students is a little daunting, you might start by identifying the students at greatest risk or those requiring individual learning plans and begin with them.

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